GENERAL LIBRARY
OCT 19
UNIV. OF MICH.

SCIENCE

NEW SERIES
VOL. L, NO. 1292

FRIDAY, OCTOBER 3, 1919

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00

JUST OUT

Heineman on Milk

This work appeals to sanitarian, physician, laboratory worker, producer, economist, and student. For instance the *sanitarian* will find chapters on adulteration and adulterants, with methods, formulas, means of detection, cause and prevention of contamination, inspection, and similar subjects of sanitary importance. For the *physician* there are chapters on such subjects as Metchnikoff's theories on fermented milk and bacterial flora; milk-borne infections, milk in infant feeding, etc. The *laboratory worker* will find complete details of technic for all tests. For the *producer*, in addition to sanitary methods there are chapters on handling, distribution, the manufacture of condensed and desiccated milk, cheese, butter, ice cream, with illustrations of new apparatus. For the *economist* and *student* generally there is here presented a complete study of the milk problems from every angle from production to consumption.

Octavo of 684 pages, illustrated. By PAUL G. HEINEMAN, Ph.D., Director of the Laboratories of the United States Standard Serum Company, Wisconsin. Cloth, $6.00 net.

Fred's Soil Bacteriology

Laboratory Manual of Soil Bacteriology. By E. B. FRED, Ph.D., Associate Professor of Agricultural Bacteriology, College of Agriculture, University of Wisconsin. 12mo of 170 pages, illustrated. Cloth, $1.25 net.

Valuable to students of soil bacteriology, chemistry, physics, plant pathology.

Whetzel's Phytopathology

History of Phytopathology. By HERBERT HICE WHETZEL, A.M., Professor of Plant Pathology, Cornell. 12mo of 130 pages, illustrated. Cloth, $1.75 net.

The outstanding features in the evolution of plant pathology.

Dietrich's Live Stock

Livestock on the Farm. By WILLIAM DIETRICH, Ph.D., Head of the Department of Animal and Dairy Husbandry, University of Minnesota, Crookston Branch. 12mo of 269 pages, illustrated. Cloth, $1.50 net.

A clear presentation of economic livestock raising.

Kaupp's Anatomy of the Fowl

The Anatomy of the Domestic Fowl. By B. F. KAUPP, M.S., D.V.M., Poultry Investigator and Pathologist, North Carolina Experiment Station. 12mo of 373 pages, illustrated. Cloth, $3.00 net.

The first complete textbook on this subject. Particularly full on embryology.

W. B. SAUNDERS COMPANY Philadelphia and London

Laboratory Supplies
+ Personal Service

There are occasions when you require more than Chemicals, Glassware and other Laboratory Apparatus or supplies. You need such equipment, to be sure, but you need, just as keenly at times, reliable suggestions in its selection and adaptation to your particular purposes.

We are peculiarly qualified to meet this double requirement—for back of our unusually complete stock of carefully selected Laboratory Supplies is an organization fitted by training and experience to give you just this personal service you are looking for.

The men composing our consulting staff include organic, analytical, manufacturing, research and industrial chemists and engineers. They have been chosen for their ingenuity and initiative, as well as their experience. They consequently enable us to give a distinct personality to our service in supplying the unusual, as well as the usual, which accounts for the number of large research laboratories numbered among our patrons.

Write for our new Glassware Catalog—or ask us for literature and advice on any of your laboratory requirements.

The Will Corporation

Glassware—Chemicals—Laboratory Apparatus

ROCHESTER, N. Y.

SCIENCE

FRIDAY, OCTOBER 3, 1919

CONTENTS

Epidemiology and Recent Epidemics: DR. SIMON FLEXNER 313

The New International Union of Pure and Applied Chemistry: PROFESSOR EDWARD W. WASHBURN 319

Scientific Events:—

Gift for the Improvement of Medical Education in the United States; Lectures on Popular Science at the University of California; The American Society of Naturalists; Award of the Willard Gibbs Medal 323

Scientific Notes and News 325

University and Educational News 327

Discussion and Correspondence:—

The Rigidity of the Earth: PROFESSORS A. A. MICHELSON AND HENRY G. GALE. *An Unusual Mirage:* DR. A. A. KNOWLTON... 327

Quotations:—

The Rockefeller Foundation 328

Scientific Books:—

Bent on Life Histories of North American Diving Birds: HARRY C. OBERHOLZER 329

Special Articles:—

Visibility of Bright Lines: DR. LOUIS BELL. 331

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

EPIDEMIOLOGY AND RECENT EPIDEMICS[1]

IT has been the custom, I am informed, at these meetings to spend little time and few words on mere felicitations, but to proceed as promptly as may be to the business of the congress. However, you will, I know, indulge me long enough to enable me to express to you in some degree the sense of honor and responsibility which I feel on this occasion.

Since the last congress, which was held in 1916, in the midst of the racking uncertainties of the great war, notable events and serious calamities have befallen the world and arrested the attention of all thoughtful men. A bitter and passionate military contest has been brought to a hopeful conclusion; but because of the unparalleled cost of the struggle, in lives and in treasure, deep unrest, revolution even, starvation and diseases are prevailing over a large part of Europe, while also within the three-year period elapsed between the last congress and the present one three destructive epidemics of disease have ravaged the United States and the world.

Hence it has seemed fitting to me that on this occasion and before this representative body of medical men we should pause for a brief period in order to review, as it were, our knowledge of epidemics and at the same time of the practical hygienic measures, based on this knowledge, which we already put or in ordinary course of events may reasonably hope to put into motion against the spread of these epidemics, so that we may form a judgment of the efficacy of such measures and arrive possibly at new points of view from which to launch a more decisive attack. Moreover, it

[1] President's address, X. Congress of American Physicians and Surgeons, held at Atlantic City, N. J., June 16 and 17, 1918. This address appears in the *Journal of the American Medical Association.*

seems imperative that we should consider not only the sum of our knowledge of epidemics, but also certain facts relating to the population affected, which react powerfully on the successful application of the hygienic means available.

Three epidemic diseases, poliomyelitis, streptococcus pneumonia and influenza, have been especially destructive in the western world during the past three years; also, because of certain common characteristics, they are well adapted for the purpose I have in view.

In the United States we are becoming increasingly familiar with epidemics of poliomyelitis. Prior to 1907 infantile paralysis was a rare disease in this country; since then it has prevailed fitfully every summer and autumn, and in one notable instance, at least, in the winter season,[2] claiming victims by the score or hundred, until in 1916 an outbreak of unprecedented severity, with its center of violence in New York state, swept over a considerable number of states.

Fundamental knowledge of poliomyelitis may be said to have grown rapidly since Wickman's epochal clinical studies published in 1907. We are indeed to-day in possession of precise information covering essential data with regard to the nature of the inciting microorganism, notwithstanding its very minute size, and also concerning the manner in which it leaves the infected or contaminated body within the secretions of the nasopharynx chiefly and gains access to another human being by means of the corresponding mucous membranes and apparently no other way. Moreover, the inciting virus so called, up to the present time and notwithstanding many and assiduous efforts, has not been detected apart from the infected or merely contaminated human being, and there is therefore no foundation in ascertained fact for an assumption that the virus is conveyed to persons otherwise than by other persons who harbor it.

The second example, namely, that of streptococcus pneumonia, presents a phenomenon almost, if not quite, new among the epidemic diseases. It appears as if during the winter of 1917–1918 there occurred in several localities within the United States and also, but in less degree, in France, at least a great increase in the incidence of a type of pneumonia which previously had been very infrequent. It appears also that the greatest number of cases and of fatalities arose in the United States in the military cantonments; that the disease first prevailed as a secondary pneumonia following measles; but that before long the severity of the infection was such that cases of primary streptococcus pneumonia began to arise. Moreover, at this juncture the disease spread from the military to the civil populations.

The nature of the microorganism inducing this form of epidemic pneumonia is indicated in the name which the disease has come to bear. The difficulty in this instance has not been in finding out the inciting microbe, but rather in differentiating the streptococci responsible for the epidemic disease from streptococci possessing the ordinary pathogenic properties, or even from those of saprophytic nature so commonly present on the upper respiratory mucous membranes without provoking widespread disease. However, numerous studies of the bacteriology of this epidemic of pneumonia, at distinct and often widely remote cantonments, showed that the microbic incitant was in almost every instance *Streptococcus hemolyticus*. Moreover, because of the wide occurrence of the epidemic pneumonia, this type of streptococcus could be found in normal throats and as a secondary invading microorganism in the lungs in cases of ordinary lobar pneumonia. Thus far very little progress has been made in the classification of streptococci, which form a class apparently even more heterogeneous than the pneumococci.

The point I wish to emphasize is this: Regarding epidemic diseases in general we are wont to assume the introduction from without and usually from a distant locality of a special kind or race of microorganism which is held directly responsible for the epidemic ensuing. In the instance of the epidemic pneumonia no such importation or new introduction of the inciting streptococcus needs to be or actually is assumed. It is so

[2] Fairmont, West Virginia.

probable as to amount to practical certainty that the excessively virulent *Streptococcus hemolyticus* was developed by a process of selection, through successive transfer from person to person, and by gradual enhancement of its invasive properties.

We are in this case on safe grounds when we assert that the inciting streptococcus is always personally borne: that is, that it leaves the respiratory organs of one person to be introduced upon the corresponding organs of other persons, and in no other manner. In other words, the mechanism or mode of infection in epidemic streptococcus pneumonia, as in poliomyelitis, may be said to be clearly apprehended.

The case of influenza, the third and perhaps the most important example cited, is quite different, since wide divergences of belief and opinion regarding the nature of the inciting microorganism and the manner of infection still prevail. The reasons for these differences are several, but the most important perhaps relate to the common observation of the manner of spread or attack of the disease. To the casual observer there is something uncanny in the way influenza strikes down its victims. While other epidemics proceed from bad to worse, with at least progressive increases in intensity, influenza seems to overwhelm communities over even wide stretches of territory as by a single stupendous blow. While in the one case the gradually accelerating rate of speed of extension may be taken to indicate personal conveyance of the provoking microorganism, in the other case the sudden wide onset appears to be the very negation of personal communication.

Hence the invoking of mysterious influences, the revival of the notion of miasm and similar agencies, to account for this phenomenon. Indeed, the public mind in general lends itself readily to such formless concepts, for the reason that there still resides in the mass of the people, even in the more enlightened countries, a large uneradicated residue of superstition regarding disease. One does not need to look far or dig deep in order to uncover the source of this superstition. We have only recently emerged from a past in which knowledge of the origin of disease was scant, and such views as were commonly held and exploited were mostly fallacious. It is indeed very recently, if the transformation can be said to be perfect even now, that the medical profession as a whole has been completely emancipated. All this is very far from being a matter of remote importance only, since in the end the successful imposition of sanitary regulations involves wide cooperation, and until the majority of individuals composing a community is brought to a fair level of understanding of and belief in the measures proposed serious and sustained endeavor to enforce them is scarcely to be expected.

And yet no better instance of a communicable disease could perhaps be invoked than influenza to exorcise the false idea of the mysterious origin of epidemics. To dwell solely on the sudden and overwhelming stroke of the disease is wholly to overlook the significant incidents that precede the mass infection, because they are of such ordinary nature and lack all dramatic quality. Accurate observers noted long ago that influenza in its epidemic form did not constitute an exception to the common rule governing epidemic diseases which were obviously associated with persons and their migrations. What the early students made out by tracing the epidemic backward to its point of departure more modern observers have confirmed by carefully kept records, often graphically compiled, as in the excellent instance of the Munich records covering the epidemic of 1889–92, which can now be supplemented by a number of similarly constructed records of the epidemic just passed. These detailed records show convincingly a period of invasion during which there is a gradual rise in the number of cases, to culminate, within a period variously estimated at from one to three weeks, in a widespread so called "explosive" outbreak of the disease.

It happens that the early cases of epidemic influenza tend not to be severe, chiefly because they rarely are attended by pneumonia and hence are frequently mistaken; and the confusion in diagnosis is resolved only when the

full intensity of the epidemic is realized. In the meantime rich opportunity has been afforded for the free and unrestricted commingling of the sick and the well, of doubtless healthy carriers of the inciting agent and others, until so high a degree of dissemination of the provoking microorganism has been secured as to expose the entire susceptible element of the population, which happens to be large, to an almost simultaneous response to the effects of the infecting microbe.

Deductions of like import can be drawn from the geographical movements of influenza epidemics. In eastern Russia and Turkestan influenza spreads with the pace of a caravan, in Europe and America with the speed of an express train, and in the world at large with the rapidity of an ocean liner; and if one project forwards the outcome of the means of intercommunication of the near future we may predict that the next pandemic, should one arise, will extend with the swiftness of the airship. Moreover, not only is this rate of spread determined by the nature of the transportation facilities of the region or the era, but towns and villages, mainland and island, are invaded early or late or preserved entirely from attack according as they lie within or without the avenues of approach or are protected by inaccessibility, as in instances of remote mountain settlements and of islands distant from the ocean lanes or frozen in during winter periods.

It is desirable, in the interest of clear thinking, to carry this consideration of the characteristics of epidemic influenza a step further. A feature of the epidemic disease of particular significance is the tendency to recur, that is, to return to a stricken region after an interval, usually of months, of relative quiescence. Thus the beginnings of the last pandemic in western Europe and the United States have been traced to sporadic cases appearing in April, May and June, possibly earlier even in certain places, while the destructive epidemic raged during September, October and November of 1918. There are very good reasons for believing that in itself influenza is not a serious disease, but that its sinister character is given by the remarkable frequency with which it is followed, under particular circumstances, by a concomitant or secondary pneumonic infection to which the severe effects and high mortality are traceable. Now it is this high incidence of pneumonia, the product of invasion of the respiratory organs with bacteria commonly present on the upper respiratory mucous membranes—streptococci, pneumococci, staphyloccocci, Pfeiffer's bacilli, and even meningococci—that stamp the recurrent waves of the epidemic with its bad name.

If we compare the pneumonic complications of influenza with those which arose in the cantonments in 1917–18, first as attendants of measles and later as an independent infection, we note immediately that in both instances the severe effects and high fatalities arose, not from bacteria brought or imposed from without, but from their representatives which are commonly resident upon the membranes of the nose and throat in health. Whatever we may have to learn of the microorganism inducing measles, still undiscovered, and of influenza, still under dispute, and their mode of invasion of the body, no one would question that the bacteria inducing pneumonia are personally borne.

With these various considerations before us we may now discuss the question of the efficiency of our public health measures in diminishing the incidence of epidemic diseases. It should now be evident that our three examples are essentially instances of respiratory infections, that is, diseases in which the inciting microorganism enters the body by way of the air passages, although not necessarily, as in poliomyelitis, directly injuring those parts. Protection in diseases of this class is not to be secured by applying sanitary measures on a wide scale to an extraneous and inanimate source of the infectious microorganism, as to water supplies contaminated with the dejecta of typhoid patients, or even to inferior animal species, such as the mosquito or the rat, which act as intermediaries in conveying the germs of yellow fever or of infectious jaundice; but it is alone to be attained by methods of personal

hygiene, applied on the individual scale of safeguarding one person from another, the most difficult of all hygienic regulations to enforce.

Returning now to epidemic poliomyelitis, we may fairly claim that we are in possession of the essential facts which, if widely applicable, should enable us to control the spread of that disease. But we can, I think, hardly claim that up to the present time our accomplishments in that direction have been remarkable. It is sufficient merely to compare the curve of incidence of the Swedish epidemic of 1905, before the nature and mode of infection of poliomyelitis were known, with those of the last several years in Massachusetts and New York state for example, in order to conclude that the progress of the epidemics in the several places was practically identical.

And, indeed, this is what might be expected in view of the difficulties surrounding the prompt and accurate diagnosis of poliomyelitis in its atypical and abortive, often ambulant forms. Once the disease is introduced under conditions favoring its epidemic spread a wide dissemination of the inciting microorganism takes place, and a constantly increasing number of persons becomes exposed to its presence, before any restrictive measures are put into effect, and indeed also after they have been applied. In the case of poliomyelitis, as in that of influenza itself, a wide distribution of the infectious agent precedes the enforcement of preventive sanitary regulations. These considerations do not, of course, warrant intermission of the protective measures now in use, which undoubtedly save many individuals from exposure and thus from potential attack; they do, however, offer an explanation of why, up to the present time, greater success has not attended efforts at control once the epidemic is under full way.

The case with the epidemic pneumonias is of another order. They represent theoretically two diseases which should respond to methods of control based upon our knowledge of their mode of infection. In the epidemic streptococcus pneumonia and the pneumonia following influenza we are dealing with pathological conditions in which not a newly introduced, extraneous microorganism is operating widely and insidiously, but in which the active microbes concerned are examples merely of intensified races of common and almost omnipresent species belonging to the flora of the nasopharynx. The infectious agents in these instances are contained within the nasal, buccal and bronchial secretions, and are disseminated in the sprayed material which is coughed or otherwise thrown into the surroundings of the patients. The lesson therefore to be derived from the severe experience of the recent pneumonia epidemics is to the effect that measles and influenza patients are not to be assembled into large groups or kept in open wards, but should be placed in separate rooms or cubicles, where they and their attendants may be preserved as far as possible from sputum droplet contamination. In the instance of epidemic pneumonia a chain of direct infection from one patient to another tends to be established, and hence the sanitary control of those diseases is to be sought through the breaking, as it were, of this vicious circle.

A distinction has now been intimated in the possibilities of direct sanitary control between the two epidemic diseases—namely, poliomyelitis and influenza—introduced from without, and the pneumonias, which are mere, if intense, exaggerations of sporadic diseases ordinarily prevailing. I propose now to lay before you a suggestion as to means of attacking the exotic epidemic diseases which may come to merit serious attention.

Epidemic diseases in the commonly accepted sense have fixed locations—the so-called endemic homes of the diseases. In those homes they survive without usually attracting special attention over often long periods of time. But from time to time, and for reasons not entirely clear, these dormant foci of the epidemics take on an unwonted activity, the evidence of which is the more frequent appearance of cases of the particular disease among the native population and sooner or later an extension of the disease beyond its endemic confines. Thus there are excellent reasons for believing that an endemic focus of

poliomyelitis has been established in northwestern Europe from which the recent epidemic waves have emanated.

Similarly, there are excellent reasons for regarding the endemic home of influenza to be eastern Europe and in particular the border region between Russia and Turkestan. Many recorded epidemics have been shown more or less clearly to emanate from that area, while the epidemics of recent history have been traced there with a high degree of conclusiveness. From this eastern home, at intervals usually of two or three decades, a migrating epidemic influenza begins, moving eastward and westward, with the greater velocity in the latter direction.

Now since the combating of these two epidemic diseases, when they become widely and severely pandemical, is attended with such very great difficulty and is of such dubious success, and this notwithstanding the prodigious public contests which are waged against them in which the advantages are all in favor of the invading microorganismal hosts, it would seem as if an effort of central rather than peripheral control might be worth discussing. According to this proposal, an effort at control amounting even to eventual eradication of the diseases in the regions of their endemic survival would be undertaken, an effort indeed not occasional and intensively spasmodic. as during the pandemical excursions, but continuous over relatively long periods, in the hope that the seed beds, as it were, of the diseases might be destroyed.

That such an effort at the eradication of a serious epidemic disease may be carried through successfully the experience with yellow fever abundantly proves. In attacking that disease the combat was not put off until its epidemic spread had begun and until new territory such as New Orleans, Jacksonville, Memphis, etc., had been invaded, but the attack was made on its sources at Havana, Panama and now Guayaquil, to which endemic points the extension into new and neutral territory has been traced.

I do not disregard the essential fact in bringing this suggestion forward, that the control at its sources of yellow fever is quite another and probably far simpler problem than the control in their endemic foci of poliomyelitis and influenza. It is perhaps unnecessary to go far into the reasons why the latter would doubtless prove to be far more difficult of accomplishment than has been the former. I am not now engaged in presenting a plan of operation or proposing that the attempt at eradication be made immediately. Our knowledge of all the facts involved in the epidemiology of poliomyelitis and especially of influenza may still be too imperfect for immediately effective action. But the very magnitude of the problem of these otherwise uncontrollable epidemic diseases invites to an imaginative outlook which, while perhaps nonrealizable to-day, may not, in view of the rapidly advancing knowledge of the infectious diseases, be hopelessly out of reach to-morrow.

Nor am I insensible to the labor and cost in money and talent which the setting out on such an ambitious enterprise would entail. But here at least is a world problem of such proportions and nature as to invite the participation of all the scientifically advanced countries in a common effort to suppress one of the most menacing enemies of civilized man and of human progress.

In proposing to strive for the high achievement, not merely of parrying the blows struck by destructive epidemics, but of rendering them impotent to strike in the future, we may pause for a moment to reflect on the different ways in which peoples react to great calamities, such as those brought by war and by disease. As the results of a cruel and devastating war, revolutions in governments supposed the most stable may occur; no such result follows upon still more devastating epidemics. The recent epidemic of influenza claimed, possibly, more victims than did the great war, and the losses to the world in emotion spent, treasure consumed and progress impeded are incalculable; yet, through a fortuitous circumstance of psychology, from the one calamity the world may emerge chastened, perhaps even bettered, while from the other, because of a depth of ignorance amount-

ing often even to fatalism, mankind may largely miss the deep meaning of the lesson.

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE NEW INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY[1]

As a result of conferences held in London and Paris in October and November, 1918, the scientific academies of the allied nations decided to recommend the dissolution of all international scientific associations in existence before the war and the reconstitution of such associations by and among the nations associated in the war against the Central Empires. As a result of this recommendation the International Association of Chemical Societies was dissolved and at a conference held in Paris in May of this year definite steps were taken toward the formation of an inter-allied chemical union.

At this conference delegates from the principal allied nations were present. A provisional organization was effected and a committee appointed to draft articles of confederation. M. Moureu, president of the Federated Chemical Societies of France was elected president and M. Gerard, temporary secretary. After drawing up a statement of the purposes of the new organization the Paris conference adjourned and issued a call for a final conference to be held in London, July 14, for the purpose of perfecting the permanent organization and of passing upon the statutes to be prepared by the special committee. In accordance with this action each of the allied countries was invited to send delegates to the London meeting.

This meeting convened in Salters Hall, London, on July 14 last, and continued its sessions until July 18. The countries represented and their delegates were as follows: Belgium—MM. Lucion and Timmermanns; France—MM. Moureu, Kestner, Behal, Marquis, Marie and Gerard; Italy—MM. O. Severini and G. Pirelli; United Kingdom—Sir William Pope, Henry Louis, H. E. Armstrong, E. F. Armstrong, A. C. Chaston-Chapman and W. P. Wynne; United States—F. G. Cottrell, C. L. Parsons, E. W. Washburn and H. S. Washington.

Practically all of the time of the conference was devoted to framing the statutes of the new international organization and the election of the officers for the first three-year term. The following officers were elected:

President—M. Ch. Moureu.

General Secretary—M. Jean Gerard (49 Rue des Mathurins, Paris).

Vice-Presidents—Georges Chavannes (for Belgium), L. Parodi Delfino (for Italy), C. L. Parsons (for the United States), Sir William Pope (for the United Kingdom).

Communications were received from Canada and Poland signifying their adhesion to the new organization and requesting admission. It was also decided to admit the neutral countries immediately, but the admission of the Central Powers was made contingent upon their admission to the League of Nations. The new union is thus to be international in character instead of merely inter-allied.

The conference also voted its approval of the organization of an International Research Council as contemplated by the Conference of Scientific Academies, and expressed its desire to be included in that organization with autonomous powers as the Chemical Section thereof. It was decided to hold the next meeting of the international chemical union in Italy early in June in 1920.

Previous to adjournment the Conference officially appointed those members of its own body who expected to attend the Brussels meeting of the International Research Council as its representatives at that meeting, for the purpose of effecting the union of the new international chemical organization with the International Research Council as its chemical branch.

The delegates thus appointed re-assembled in Brussels on July 22. This meeting was largely devoted to the discussion, modification and final adoption of the statutes of the

[1] Address delivered at the Fifth National Exposition of Chemical Industries at Chicago, September 25, 1919.

new International Union of Pure and Applied Chemistry.

In confirmation of action taken at the London meeting it was voted that a critical compendium of physical and chemical constants should be prepared and published under the auspices of America as part of her contribution toward an international program of documentation which the new union proposed to proceed with as rapidly as possible. The formation of the necessary editorial board for carrying this project into effect and the necessary arrangements for financing it, are now progressing toward completion under the direction of the National Research Council of the United States. This undertaking while primarily under the direction of an American committee which will be charged with complete responsibility, both editorial and financial, will nevertheless be conducted on an international basis with assistant editors and collaborators in the principal nations of the Union. The majority of the delegates felt strongly that in nearly all cases where a program of work was adopted by the Union, the most efficient manner of accomplishing it was to center the responsibility for each part in a given country, rather than to form a central international committee with a consequent distribution of the responsibility.

The purposes of the International Union of Pure and Applied Chemistry and its present composition as set forth in Article I. of the Statutes are as follows:

ARTICLE I

1. Each of the following countries—Belgium, United States of America, France, United Kingdom of Great Britain and Ireland, and Italy, through the agency of its National Research Council (Chemistry Division), or its Federal Council of Chemistry, or failing such national federation, through the agency of a national chemistry association—joins with the others in the formation of an International Union of Pure and Applied Chemistry, having for its objects the following:

(*a*) To cement among the allied peoples the bonds of friendship and mutual esteem which have been developed and strengthened during the course of the war.

(*b*) To organize permanent cooperation between the chemical associations of the different countries.

(*c*) To coordinate their scientific and technical activities.

(*d*) To contribute to the advancement of chemistry in all its branches.

2. The Union thus constituted shall be perpetual. Its provisional headquarters shall be in Paris.

The admission of a nation to the Union is effected through some organization within that nation which substantially constitutes a federation of the principal chemical societies of the country. Thus the United Kingdom of Great Britain and Ireland joined the Union through her Federal Council for Pure and Applied Chemistry, France joined through her Federation Nationale des Associations de Chemie Pure et Appliquée, Italy through her Associazone Italiana di Chimica Generale ed Applicata and the United States of America through the Division of Chemistry and Chemical Technology of the National Research Council. Ultimately it is the expectation that in each nation there will be formed a National Research Council somewhat similar to our own and when this is formed, the National Chemical Federation will become merged with it as the chemical division.

The voting strengths, number of delegates and financial contributions of the countries belonging to the Union are fixed in accordance with six categories determined by population. The new Union is to be administered by a Council composed of the delegates of the constituent countries and between meetings of the Council by the Committee of Officers, composed of the president, the four vice-presidents and the general secretary. The statutes also provide that annual meetings of the Union shall be held. The other provisions of the statutes have to do principally with the machinery of operation, method of voting, financial provision conduct of meetings, duties of the officers, etc.

Owing to the fact that the drawing up and adoption of the statutes consumed practically all of the time of the delegates both at the London and at the Brussels meeting, there was practically no opportunity to consider at length the various projects which the Union should undertake and it is therefore probable that the Rome meeting will be devoted largely to drawing up a program of work.

The fact that the new Union is a union of national federations in a position to act for all the chemical interests of the countries which they represent, and having frequent meetings throughout the year, should make it possible for this new international organization to function more efficiently than the previous International Association of Chemical Societies, and it is hoped that the new organization will accomplish valuable work for the science and for the chemists of the world.

EDWARD W. WASHBURN,
Acting Secretary of the American Delegation

STATUTES OF THE INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY (FREE TRANSLATION OF THE FRENCH TEXT)

Article I

1. Each of the following countries—Belgium, United States of America, France, United Kingdom of Great Britain and Ireland, and Italy, through the agency of its National Research Council (Chemistry Division), or its Federal Council of Chemistry, or failing such national federation, through the agency of a national chemistry association—joins with the others in the formation of an International Union of Pure and Applied Chemistry, having for its objects the following:

(*a*) To cement among the allied peoples the bonds of friendship and mutual esteem which have been developed and strengthened during the course of the war.

(*b*) To organize permanent cooperation between the chemical associations of the different countries.

(*c*) To coordinate their scientific and technical activities.

(*d*) To contribute to the advancement of chemistry in all its branches.

2. The Union thus constituted shall be perpetual. Its provisional headquarters shall be in Paris.

Article II

1. The conditions governing the admission of a country to the Union shall conform to those fixed by the statutes of the International Research Council.

2. A country may join the Union through its "national chemical federation," *e. g.*, through its National Research Council (Chemistry Division), or through its Federated Council of Chemistry, or failing such organization, through a national association representing chemistry. (*Translator's Note.*—The purpose of this paragraph is to provide for the formation in each country of some national agency which shall federate all of the major chemical organizations of the country. Thus in the United States this federation is effected through the Chemistry Division of the National Research Council, while in England it is effected through her Federal Council of Chemistry. Ultimately it is expected that in each country the federating agency will become merged in the National Research Council of that country in the capacity of its Chemistry Division.)

Article III

1. The functions of the Union as set forth in Article I. shall be exercised through a council, assisted by an administrative secretary and by a special staff or bureau, the establishment and duties of which shall be determined by international agreement among the constituent countries.

Article IV

1. The annual subscription for each country is fixed at a rate dependent upon the number of its inhabitants, in accordance with the following categories:

		Population in Millions of Inhabitants	Minimum Annual Subscription
Category	A.....	less than 5	500 francs
"	B.....	from 5 to 10	1,000 "
"	C.....	from 10 to 15	1,500 "
"	D.....	from 15 to 20	2,000 "
"	E.....	from 20 to 30	2,500 "
"	F.....	more than 30	3,000 "

2. The inhabitants of any non-self-governing colonies or protectorates of a country may, at the discretion of that country and in accordance with its own census data, be counted with its own inhabitants.

3. No member of the Union may without its own consent be assessed by the Union to provide funds for other than general administrative expenses.

Article V

1. Any member of the Union may withdraw therefrom, provided said member shall have fulfilled all of its current obligations.

2. A member of the Union may be expelled or dropped from membership by a three fourths vote of the members of the council, either present or represented, for non-payment of the minimum annual subscription or for a serious offense, the member having previously been called upon to furnish explanations.

Article VI

1. The Union shall be administered by a council composed of the delegates of the constituent countries, the numbers and distribution of such delegates to be determined by the categories of Article IV. in accordance with the following table:

	Delegates
Category A	1
" B	2
" C	3
" D	4
" E	5
" F	6

2. These delegates shall be appointed for a term of three years by the "National Chemical Federation" of the respective countries. One third of the membership of the council shall retire annually but the retiring members shall be eligible for reappointment.

Article VII

1. The executive functions of the council shall be exercised through a committee of the officers which shall be a president, four vice-presidents, and a general secretary. These officers shall be elected by the council from among its own membership by a majority vote. They shall serve for terms of three years, and with the exception of the general secretary shall not be eligible for immediate reelection to the same office. The president shall be chosen from among the vice-presidents.

Article VIII

1. The council shall meet at least once a year on the day before the annual general meeting in the town where the latter is to be held, and, in addition, as often as it shall be convened by its president, or upon the requisition of one fourth of its members.

2. The council shall fix the date and place of meeting, draw up the budget, and decide as to expenses.

3. Resolutions shall be adopted by a majority.

4. On questions of an administrative or financial nature the voting shall be by countries, each country having a number of votes equal to the number of its delegates. In such voting it is, however, not necessary that all these delegates be present. The delegates of any country may appoint one or several proxies to represent them and to vote in their name.

5. Voting by correspondence is permitted.

6. All questions to be voted upon must appear on the agenda of the meeting.

7. The president shall have the casting vote in case of a tie.

Article IX

1. Minutes shall be kept of all meetings. Two copies of the minutes shall be prepared and signed by the chairman and the secretaries of the meeting.

2. The permanent secretarial staff shall have the custody of the archives, and shall be entrusted with the execution of the decisions taken by the council and by the committee of officers and in particular with the circulation of the agenda.

Article X

1. The functions of the committee of officers shall be:

(*a*) To see that the rules are strictly observed.

(*b*) To prepare the agenda for meetings of the council.

(*c*) To record and carry out the decisions of the council.

(*d*) To perform during the entire period elapsing between two meetings of the council the necessary acts of administration and to report the same in writing to the members of the council.

(*e*) To submit to the council a draft yearly budget.

(*f*) To represent the Union or to appoint its representatives.

Article XI

1. There shall be instituted, in addition to the council, a consultative committee, consisting of as many sections as shall be necessary to ensure the complete representation of pure and applied chemistry in conformity with the regulations of the Union.

Article XII

1. The general assembly of the Union shall consist of the members of the council and of the delegates of the "National Chemical Federations" of the constituent countries.

2. A regular meeting of the general assembly shall be held at least once a year, preferably at the time and place of the meeting of the International Congress of Pure and Applied Chemistry.

3. The general assembly shall also meet when called together by the council or when such a meeting is requested by at least one half of the members of the Union.

4. The general assembly shall receive reports on the administrative work of the council on its financial situation, and on the general condition of the Union.

5. It shall approve the accounts of the previous fiscal year as certified by an auditor, selected from outside the membership of the council and appointed by the general assembly of the preceding year.

6. It shall pass upon the budget for the next fiscal year and shall discuss those questions appearing upon its agenda.

7. The annual report and the accounts shall be sent each year to all the members three months in advance of the annual meeting of the general assembly. The agenda of the general assembly shall be drawn up by the council and must include every question which shall have been transmitted to it by any of the members of the Union three months in advance of the meeting of the general assembly.

8. The officers and executive committee of the general assembly shall be identical with those of the council.

9. Votes on administrative and financial questions shall be cast by countries, each country having the number of votes indicated in the categories of Article VI.

10. The delegates of any country may appoint one or several proxies to represent them and to vote in their name.

Article XIII

1. All expenditures shall be authorized by the president and disbursed through the administrative secretary.

2. The spokesman and representative of the Union before the public and in all legal matters and court proceedings shall be its president, who may, however, delegate his powers in this respect to the administrative secretary or to any member of the council.

Article XIV

1. Resolutions of the council relating to such purchases, exchanges, and transfer of real property as may be needed for the accomplishment of the objects of the Union, grant of mortgages on the said properties, leases for more than nine years, transfers of properties and loans, must be submitted to the general assembly for approval.

Article XV

1. Amendments to these statutes may be considered and voted upon by the general assembly only when submitted thereto by the council of the Union or proposed by a "national chemical federation" of one of its constituent countries. All such proposed amendments shall appear upon the agenda of the meeting of the general assembly, provided they have been received in writing by the committee of officers at least three months in advance of the meeting.

2. Voting upon amendments shall be by countries in accordance with the categories of Article VI.

3. Voting by correspondence is permitted.

4. The statutes may be amended only by a two thirds majority of the votes cast.

Article XVI

1. In the event of a meeting of the general assembly being convened to decide upon the dissolution of the Union, special notices to that effect shall be sent three months in advance; and at least three quarters of the members of the Union or their proxies must be present. If this proportion is not reached, the general assembly shall be adjourned for not less than six months, when the decision of the adjourned meeting shall be operative, irrespective of the number of members present.

In any case, dissolution can only be resolved upon by a majority of two thirds of the votes cast.

Article XVII

1. In the event of dissolution the general assembly shall appoint one or more trustees to liquidate the property of the Union; and any surplus assets shall be donated to an international institution.

Article XVIII

1. In the interpretation of these statutes the French text shall be authoritative.

EDWARD W. WASHBURN,
Acting secretary of the American Delegation

SCIENTIFIC EVENTS

GIFT FOR THE IMPROVEMENT OF MEDICAL EDUCATION IN THE UNITED STATES

JOHN D. ROCKEFELLER has given to the General Education Board, founded by him in 1902, $20,000,000, to be used for the improve-

ment of medical education in the United States. The following announcement has been made:

"The General Education Board announces a gift from John D. Rockefeller of twenty millions of dollars, the income to be currently used and the entire principal to be distributed within fifty years for the improvement of medical education in the United States."

The working capital previous to this accretion amounted to between $35,000,000 and $40,000,000. Since the present sum is to be devoted exclusively to medical education, whereas the board's previous resources, under the terms of the charter granted it by Congress, have been devoted to "promoting education within the United States, without distinction of race, creed or sex," the activities of the organization with respect to medical teaching will be greatly increased.

The board will meet in December, at which time a detailed program with respect to medical education will be mapped out.

Mr. Abraham Flexner, secretary of the board, stated in a general way that just as the board in the past out of its general funds has made considerable donations to the treasuries of medical schools of such universities as Yale, Johns Hopkins, Chicago and Washington in St. Louis, it will, as soon as its plans are worked out, spend large sums for the improvement of the hospital facilities, the teaching staffs and the laboratory facilities of such schools as are decided to be worthy of help. It was pointed out that under the terms of the gift while the entire principal must be distributed within fifty years, there is nothing to prevent the concurrent distribution of both principal and interest and this, he said, undoubtedly would be done.

Mr. Flexner stated that there would be a general survey of the schools of the country which would determine not only which ones could be improved, but also what were the specific needs in each instance. The needs of all parts of the country would be taken into consideration in apportioning such sums as it is decided to disburse from the fund.

LECTURES ON POPULAR SCIENCE AT THE UNIVERSITY OF CALIFORNIA

The Sunday afternoon lectures on popular science topics given the research men of the University of California and Stanford University and the local representatives of the various United States Bureaus under the auspices of the California Academy of Sciences in the Museum in Golden Gate Park are serving a good purpose in bringing into closer relations the scientific expert and the public. The following illustrated lectures have been announced:

October 12: Dr. Walter P. Taylor, assistant biologist, United States Biological Survey, Washington, D. C., on "The flora and fauna of Mount Rainier."

October 19: Mr. C. A. Kupfer, forest investigator, United States Forest Service, San Francisco, on "California's future; what the Forest Service is doing to determine and meet the coming demands for timber and other National Forest resources."

October 26: Mr. R. F. Hammatt, in charge information, United States Forest Service, San Francisco on "Some forestry problems, both government and private."

November 2: Mr. F. D. Douthitt, grazing examiner, United States Forest Service, San Francisco, on "Range management on the National Forests in California."

November 9: Mr. Don P. Johnston, assistant district forester, United States Forest Service, San Francisco, on "Industrial research in the Forest Service."

THE AMERICAN SOCIETY OF NATURALISTS

The American Society of Naturalists will hold its thirty-seventh annual meeting at Princeton University, on Tuesday and Wednesday, December 30 and 31. The society will offer, beginning on Tuesday morning, December 30, a program to which its members are invited to contribute papers.

A symposium on "Some Relations of Biology to Human Welfare" will be presented on Tuesday afternoon.

The Naturalists' dinner will be held on the evening of Tuesday. At the close of the dinner Edward M. East will give an address entitled "Population."

Titles of papers offered by members of the society, with estimated length of delivery and statement of lantern or chart requirements, must be in the hands of the secretary by December 1. It is desired that papers be short and it should be remembered that the interests of the Naturalists are primarily in problems of organic evolution. The papers on the program will in general be arranged in order of the receipt of title except that papers on similar subjects may be grouped.

Attention is called to the change in the constitution by which a nomination for membership must now remain in the hands of the executive committee for at least one year before action can be taken upon it. Therefore, nominations to receive attention in 1920 must reach the secretary by December 31, 1919. Blank forms for nomination may be obtained from the secretary, Bradley M. Davis, Botanical Laboratory, University of Michigan, Ann Arbor, Mich.

AWARD OF THE WILLARD GIBBS MEDAL

THE Willard Gibbs gold medal was presented on September 26 to Professor William A. Noyes, director of the department of chemistry at the University of Illinois, for special work in chemistry for the government performed during the war.

The presentation was made following a reception and dinner to Professor Noyes by more than four hundred of the country's leading chemists and educators, who were in attendance at the Fifth National Exposition of Chemical Industries, held at the Coliseum, Chicago. The presentation speech was made by Dr. William H. Nichols, of New York, president of the American Chemical Society, following a brief history of the achievements of Dr. Noyes by L. V. Redman, of Chicago.

Dr. Harry Pratt Judson, president of the University of Chicago; Dr. W. E. Stone, president of Purdue University; Dr. Ira Remsen, past president of Johns Hopkins University; Dr. David Kinley, acting president of the University of Illinois, and Harry H. Merrick, president of the Chicago Association of Commerce, gave short addresses, pointing out the prominence which American science has attained in the chemical work, and of the successful efforts now under way to apply the thousands of war secrets to commercial uses.

SCIENTIFIC NOTES AND NEWS

DR. W. A. HERDMAN, professor of zoology in the University of Liverpool, who has been general secretary of the British Association for the Advancement of Science since 1903, has been elected president of the association.

THE Triennial Council of the United Chapters of Phi Beta Kappa elected at the recent meeting at Harvard University as the new president of the United Chapters for the term, 1919–22, President E. A. Birge, of the University of Wisconsin. He succeeds Professor E. A. Grosvenor, of Amherst College.

DR. HUGH CABOT, professor in the Harvard Medical School and chief surgeon at the Massachusetts General Hospital, has been appointed chief surgeon of the University of Michigan. He expects to take up his new work about January 1.

DR. ISADORE DYER has been appointed a colonel in the Medical Section, Officers' Reserve Corps. Dr. Dyer was made a member of the Council on Medical Education of the American Medical Association at the meeting of that organization held in Atlantic City in June.

DR. C. LEO MEES resigned as president of Rose Polytechnic Institute on September 1, and retires on a pension under the Carnegie Foundation, at the age of sixty-six, his retirement being due chiefly to impaired health. President Mees has been a teacher for forty-four years, thirty-two of which have been spent at Rose. For seven years he served as professor of physics, and for twenty-five years as president. He has been appointed president emeritus by the board of managers.

DR. F. C. BROWN has resigned his position as associate professor of physics, University of Iowa, and accepted a position as technical assistant to the director of the Bureau of Standards. He has, during the war, been doing scientific work in connection with aircraft

armament problems of the Ordnance Department as major in the U. S. Army.

Professor Bailey Willis, who succeeded Dr. Branner in the department of geology at Stanford University, will hereafter be in residence from January to June only, and will devote the balance of the year to geologic research and field work.

Professor Daniel Starch, of the University of Wisconsin, is on leave of absence for the first half of the present year. He is giving a three-hour course of lectures during the semester at Harvard University.

Dr. James W. Glover, professor of mathematics and insurance at the University of Michigan, spent the month of September in New York City, serving as acting president of the Teachers Insurance and Annuity Association of America. Professor Glover is a member of the board of trustees and acted for Dr. Henry S. Pritchett, who is spending the summer in the west.

Dr. R. H. Sylvester, clinical psychologist at the Iowa State University, Iowa City, has been selected as chief of the health center at Des Moines, with headquarters in the court house.

The Pontécoulant Prize of the Paris Academy of Sciences has been awarded to Professor A. S. Eddington for his astronomical researches.

Dr. Barton Warren Evermann, director of the museum of the California Academy of Sciences, with Dr. John Van Denburgh, the herpetologist, left San Francisco on September 11, for the Olympic Mountains in Washington. The party will be joined in Seattle by Mr. C. J. Albrecht, director of vertebrate exhibits of the Washington State Museum, and a photographer, and an effort will be made to obtain motion pictures of the Roosevelt Elk in their native haunts in these mountains. The films if successful will be used to supplement the story told by the habitat group of Roosevelt Elk, now being installed in the Academy's Museum in Golden Gate Park, through the munificence of Captain William C. Van Antwerp.

We learn from *Economic Geology* that T. Wayland Vaughan, D. Dale Condit, C. Wythe Cooke and Clyde P. Ross, of the U. S. Geological Survey, have recently returned to Washington after spending several months in a reconnaissance of the Dominican Republic, for the Dominican government. Dr. Vaughan also visited Prince au Prince, Haiti, and made arrangements with the Haitian government for a preliminary geological survey of Haiti. He later made a reconnaissance in the Virgin Islands at the request of the Navy Department. Mr. Condit, who was in charge of the field work in Santo Domingo, has in preparation several reports one of which, soon to be published, will describe the results of geologic work in Barahona and Azua Provinces.

The James Watt centenary celebrations in Birmingham were opened with lectures by Professor F. W. Burstall and Professor Hele-Shaw on September 10. In the afternoon there was a memorial service at Handsworth Parish Church, in which Watt, Boulton and Murdoch were buried, an address being delivered by Canon E. W. Barnes, Master of the Temple. This was followed by a garden-party at Heathfield Hall, and a reception by the Lord Mayor at the Council House. The following day lectures were given by Sir Oliver Lodge, Professor Alex. Barr and Professor J. D. Cormack, and in the afternoon visits were made to some of Watt's engines. In the evening the centenary dinner was held. The university held a special Degree Congregation to confer honorary degrees on the American Ambassador (the Honorable J. W. Davies), Sir Charles Parsons, Vice-Admiral Goodwin, M. Rateau (of Paris), Sir George Beilby, Colonel Blackett, Professor Barr and Mr. F. W. Lanchester.

The death is announced on August 5 of Mr. W. D. Dallas, who was scientific assistant to the meteorological reporter to the government of India from 1882 to 1906.

The *Deutsche medizinische Wochenschrift* of May 29, as quoted by the *Journal* of the American Medical Association, gives the total losses of Germany as 6,873,415. This includes

the 615,922 soldiers held prisoners of war in other lands, and the 4,207,023 wounded. The dead numbered 1,676,696, and the missing most of whom are presumably dead, 373,770, a total of 2,000,000 killed in the war.

UNIVERSITY AND EDUCATIONAL NEWS

THE will of General Horace W. Carpentier has now been filed. The estate is valued at $3,606,000. The principal beneficiaries are Columbia University and Barnard College, each of which receives $1,420,000. Other beneficiaries include the Presbyterian Hospital, $200,000; Sloan Hospital, $200,000, and the University of California, $100,000.

BY the will of the late Charles W. Lenney, of New York, $50,000 is left to Boston University.

MR. ARTHUR BALFOUR has been nominated for election as chancellor of Cambridge University, in succession to his brother-in-law, the late Lord Rayleigh.

COLORADO COLLEGE has again opened its forestry school, which was closed for two years because of the war. Mr. J. Gordon Parker has been appointed assistant professor of forestry in charge of the school.

A NEW department of physiological chemistry has recently been established at the University of Kansas. Dr. C. Ferdinand Nelson has been elected professor of biological chemistry and head of department.

AT Yale University Arthur Phillips, M.S., has been appointed assistant professor of metallurgy, in the Sheffield Scientific School; James Albert Honeij, M.D., at present assistant professor, professor of clinical medicine in charge of radiology, and Wilder Tileston, M.D., at present assistant professor of medicine, professor of clinical medicine.

DR. C. W. HEWLETT, professor of physics in the North Carolina College for Women, Greensboro, N. C., has been appointed assistant professor of physics at the University of Iowa.

RECENT appointments in the medical school of Loyola University, Chicago, are as follows: S. A. Matthews, M.D., professor and head of the department of physiology, pharmacology and therapeutics; A. C. Ivy, A.M., Ph.D., formerly instructor in physiology at the University of Chicago, associate professor in physiology; E. S. Maxwell, formerly instructor in pathology at Vanderbilt University and more recently first lieutenant in the U. S. Medical Corps, associate professor in bacteriology and pathology.

DR. HARRISON R. HUNT has resigned as assistant professor of zoology at West Virginia University to become head of the department of biology at the University of Mississippi, Oxford, Mississippi.

DR. J. W. SHIPLEY, professor of chemistry in the Manitoba Agricultural College, has resigned his position in order to accept an appointment as assistant professor in chemistry in the University of Manitoba.

DISCUSSION AND CORRESPONDENCE

THE RIGIDITY OF THE EARTH

TO THE EDITOR OF SCIENCE: An account of an experiment to determine the rigidity of the earth was published in *The Astrophysical Journal* and in *The Journal of Geology*, March, 1914 and in SCIENCE, June 26, 1914. This gave the ratios of the amplitudes of tides observed in N.–S. and E.–W. pipes to the amplitudes computed for the same pipes on the assumption of a perfectly rigid earth, as .523 and .710 respectively.

The work of reducing a new set of automatically recorded observations made by an interference method, which was interrupted by the war, was recently resumed, and it was found that the N.–S. and E.–W. ratios were very nearly equal to each other.

It was then noted that $\frac{.523}{.710} = .7366$ and that the cosine of the latitude of Yerkes Observatory, where the experiment was performed, is .7363. It seemed highly probable therefore that $\cos\phi$ had been introduced erroneously into the computed formula far the N.–S. tides.

We have just been informed by Professor

Moulton that he has gone over the old formulæ used and has found that the computer introduced the factor $\cos\phi$ erroneously into the N.–S. computation.

The N.–S. ratio should therefore have been $\frac{.523}{.7363} = .710$, which oddly enough is exactly equal to the E.–W. ratio.

The new observations point to a value of about .69 for both E.–W. and N.–S. ratios.

A. A. Michelson,
Henry G. Gale

The University of Chicago,
September 10, 1919

AN UNUSUAL MIRAGE

Most people are probably familiar with the type of mirage often seen over paved streets on still hot days. In its simplest and most common form one appears to see merely a wetted portion of the pavement some distance ahead. In more striking cases this assumes the appearance of a pool of water in which buildings, trees and vehicles are seen reflected. As is well known this is due to the presence just above the pavement of a layer of air which being warmer than that above it is lighter and hence has a lower index of refraction than the air a little distance from the surface of the earth. These mirages are oftenest seen in mid-afternoon, and when motoring through the country such a pool often appears to continually recede and thus remains in sight for a long time. Recently while traveling from San Francisco to Portland with Professor W. C. Morgan we encountered such a mirage under rather unusual conditions.

The section of the Pacific Highway which traverses the Sacramento valley being paved with cement and under a hot sun is an ideal place for such mirages which had been visible much of the afternoon. Just after dusk (about nine o'clock) a car with powerful lights came over a slight rise a mile or so ahead. A moment later the lights of a second car appeared some distance in front of the first as though the driver had just turned them on. These lights were about half as brilliant as those of the first car and the impression was that two cars were approaching—a small one followed by a larger one. The large car was seen to gradually overtake the small one until finally the two sets of lights coalesced and a minute later we met and passed—a single car. "I thought there were two of them," said Dr. Morgan. So did I. We had seen a mirage at night.

A. A. Knowlton

Reed College

QUOTATIONS

THE ROCKEFELLER FOUNDATION

A review of the work of the Rochefeller Foundation in various countries during 1918 by the president, Mr. George E. Vincent, shows that its activities extended literally from China to Peru. The foundation has shown practical interest in advanced medical education in hygiene in two ways. In the first place it has by gifts for building, equipment, and maintenance, rendered possible the opening last October of the school of hygiene and public health at Johns Hopkins University in Baltimore. In the second place it has, since 1915, followed the policy of granting a number of international fellowships and scholarships to students from foreign countries and American missionaries at home on leave. In 1918 there were 68 fellowships and scholarships distributed as follows: Brazilian physicians 3, Chinese graduate physicians 11, Chinese undergraduate medical students (formerly students of the Harvard Medical School of China) 10, Chinese pharmacists 3, Chinese nurses 6, medical missionaries on furlough 26, candidates under consideration for the new schools at Peking and Shanghai 9. The International Health Board has adopted a system of "study leave," by which members of its staff of medical officers, now nearly 60 in number, may, under favorable conditions of salary, pursue at the expense of the board special courses in public health at leading American or foreign institutions. In this way the equivalent of additional graduate fellowships has been created. Provision was also made for the bringing to the United States French medical men for special train-

ing in antituberculosis measures, but no appointments were actually made in 1918. A commission for the prevention of tuberculosis, at the head of which was Dr. Livingston Farrand, opened a campaign in France in July, 1917. Although there were in existence examples of every agency effective in combating tuberculosis, they were few in number and there was no centralized organization for a combined attack on the disease. The commission, in cooperation with the Tuberculosis Bureau of the American Red Cross, set about demonstrating the value of "team play" by organizing and coordinating the essential agencies. In 1918 four central dispensaries and six secondary centers were opened. Nurses attached to these centers visited patients at their homes; the Red Cross provided hospital accommodation, opened sanatoriums, and supplied food and clothing. Efforts were made to establish local committees in the leading towns. At the time of the first visit twenty-one dispensaries were in existence in twenty-seven departments. By the end of the year fifty-seven new dispensaries had been opened, twenty others were in process of installation, and plans had been agreed upon for forty-nine more. Besides these dispensaries, fifteen laboratories were in course of establishment and forty new committees organized. An active propaganda was carried on throughout the country by means of "tanks," posters, lectures, demonstrations, pamphlets, postcards, exhibits and games. The services of the press and of art were enlisted as agents in the education of the people. The Foundation has also made experiments in the control of malaria. In four towns in Arkansas measures for the extermination of anopheline mosquitos were carried out with marked success. By draining and filling pools, ditching sluggish streams, and oiling surface water, the breeding of the insect was almost entirely prevented. The results were striking. In Hamburg, Arkansas, the number of visits paid by doctors to patients suffering from malaria fell from 2,312 in 1916 to 259 in 1917 and to 59 in 1918, a reduction for the period of 97.4 per cent. In four other communities the percentage of reductions varied from 95.4 to 80 per cent. In Sunflower county, Mississippi, it was believed that a malaria control of 80 per cent. was achieved. In regions where surface water can not be dealt with "carriers" are looked for and treated. In Guatemala an epidemic of yellow fever was checked. Work for the relief and control of hookworm disease was carried out in cooperation with twelve states of the union and with twenty-one foreign countries. In China the construction of the fifteen buildings of the Peking Union Medical College College was steadily proceeded with in 1918. An account of this institution was given in the *British Medical Journal* of August 2, 1919. On account of the glazed green tiles used to cover the roofs the College is called by the Chinese "the Green City."—*The British Medical Journal.*

SCIENTIFIC BOOKS

Life Histories of North American Diving Birds, Order Pygopodes. By ARTHUR CLEVELAND BENT. Bull. 107, U. S. Nat. Mus., August 1, 1919. Pp. i–xiii; 1–245; Pls. 1–55.

Since the discontinuance of Major Charles E. Bendire's "Life Histories of North American Birds" there has appeared no comprehensive work on this subject. Students of the life and behavior of most North American birds have been much handicapped by the lack of published information, and the widely scattered character of such as is available. In preparing a biography of a North American bird it is frequently still necessary to turn back to the works of Audubon and Wilson for data. In few groups is this lack more evident than in those that form the subject of the present work, *i. e.*, the three families, Colymbidæ (grebes), Gaviidæ (loons), and Alcidæ (auks), unwisely associated in the "Order" Pygopodes of the classification of the Check-List of the American Ornithologists' Union.

The present author has done science a service by bringing together and presenting in serviceable form the obtainable data on these groups of birds. From a large number of ornithologists to whom due acknowledgment is made, the author has received original con-

tributions or other assistance. The geographic distribution of the various species has been largely compiled by Dr. Louis B. Bishop and Mr. F. Seymour Hersey, while the biographies of two species—*Fratercula arctica arctica* and *Plautus impennis,* have been written by Dr. Charles W. Townsend. An effort has been made to have the account of each species as complete as possible, and judicious quotations from literature have been used whenever original information was not available; yet, as is with naïve modesty said in the author's introduction, "No one is so well aware of the many shortcomings and omissions in this work as the author. Allowance must be made for the magnitude of the undertaking. If the reader fails to find mentioned in these pages some things which he knows about the birds, he can blame himself for not having sent them to the author."

The method of treatment is decidedly modern, and facilitates reference to any portion of the information presented. Each one of the 36 species and subspecies is treated separately, but undue repetition is avoided under subspecies. These individual biographies range in length from less than two to nearly thirteen pages, and, notwithstanding their scientific accuracy, are for the most part pleasantly written. The account of the loon (*Gavia immer*) is particularly interesting. We are sorry to see, however, that the author still retains the possessive case for common names of birds dedicated to individuals.

The data under each species is arranged in two general categories, "Habits" and "Distribution." Under the former the subheadings are arranged, it will be noticed, as far as possible according to the sequence of the seasons. "Spring," "Courtship," "Nesting," "Eggs," "Young," "Plumages," "Food," "Behavior," "Fall," and "Winter." Under "Distribution" appear "Breeding Range," "Winter Range," "Spring Migration," "Fall Migration," "Casual Records," and "Egg Dates." Of course, owing to the lack of information, all these headings are not to be found under every species. An introductory paragraph under "Habits" gives general information that could not be satisfactorily distributed under the subheadings.

Under "Spring" general information is given regarding spring migration and habits during this period and until the breeding season, except that relating to courtship, which is reserved for a special paragraph. "Nesting" includes the dates of breeding, the location and description of the nest and its environment, and the habits of the species during this period. The paragraph on eggs concerns their number, character, color, dimensions, incubation, and similar facts. The section devoted to the young gives principally their habits until they are able to take care of themselves, together with the manner in which their parents provide for them. Under the heading "Plumages" there is a great deal of original and valuable information, including more or less complete descriptions of the various stages of plumage and succession of molts from that of the nestling to that of the adult, which in the birds covered by the present contribution has been little understood. Under "Food" there is given a résumé of the present knowledge of the kinds of food and their relative importance, together with notes on feeding habits. Under "Behavior" there is a general account of the various activities of the birds, particularly their flight, swimming and diving habits, vocal powers, general actions, and their enemies. The paragraph headed "Fall" concerns chiefly the autumn migration and the habits of birds during this period; and that relating to "Winter" contains similar data.

The information regarding geographic distribution has evidently been worked out with considerable care, and is one of the most valuable parts of this bulletin. For this purpose indebtedness is acknowledged to the files of data in the Biological Survey of the United States Department of Agriculture. The breeding range is given in considerable detail and, as we like to see it, with the limits in each direction outlined. The same is true of the winter range. In "Spring Migration" and "Fall Migration" no general statement of routes is given, but simply various data of arrival and departure at different points through-

out the North American ranges of the species. The casual records are added separately, but, we regret to see, with altogether too little specifie data. The egg dates are generalized records taken from a great mass of data and are usually given for one or two states with only inclusive dates.

Disclaiming any attempt at critical treatment of the questions of relationship, our author, however, occassionally adds comments of this character. One of the most interesting of these relates to that peculiar form *Uria ringvia,* which some ornithologists consider a distinct species, and others a mere aberration of *Uria troille.* Mr. Bent presents the data on both sides of this question, but seems to think that the bird is a distinct species. Other important critical remarks are given under *Gavia arctica arctica,* which is shown to be extralimital so far as North America is concerned. The records ascribed to this are considered all properly referable to the recently described *Gavia viridigularis* Dwight, which is here treated as a subspecies of the European *Gavia arctica.*

"The Life Histories of North American Diving Birds" is unusually well illustrated. The 43 black and white full-page plates represent nearly twice that many scenes in the life of the various species, and consist of half tones showing habitat, nests, eggs, young, and sometimes also adult birds; many of these are of much scientific interest and add greatly to the instructiveness and interest of the book. The 12 colored plates represent the eggs of many of the species. These are apparently of natural size, but there is, unfortunately, no indication on the plates or elsewhere that this is the case.

It is manifestly impossible in the brief space of a review to do justice to this work, crowded as its pages are with information; but one thing we may say, and with truth, that "The Life Histories of North American Diving Birds" is one of the most important contributions to North American ornithology, and will for a long time be the recognized authority on biography of the species that it treats.

HARRY C. OBERHOLSER

SPECIAL ARTICLES

VISIBILITY OF BRIGHT LINES

THERE has been a material amount of investigation regarding the visibility of dark lines against a light background. Seeing a linear object is much easier than seeing a spot of similar minimum dimension, and totally different from resolving parallel lines, which must be distinct as a whole before there is the least chance of resolution. In general terms distinct lines or spots can, with difficulty, be resolved when distant 1′, to judge from the average of many experiments,[1] depending on relative contrast of the objects and other experimental conditions, and barring occasional cases of highly abnormal acuity, $V = 5$–8, such as those reported by Cohn.[2] A single spot, white on black or black on white can be detected by one with fairly keen vision down to a diameter of 30″, by an occasional observer to half this value, again depending on conditions and background, with some advantage on the side of white on black as being less adversely affected by irradiation. A careful distinction should be drawn between the case here considered of contrasted bodies returning light diffusely, and that of directed specular reflection as from a mirror reflecting the sun. This latter visibility, as in the observation of a star, seems to depend chiefly on the minimum stimulus value for the retina under the existing conditions of adaptation. Humboldt records in his "Cosmos" the observation of a heliograph mirror when subtending an angle of only 0″.43, and Professor Hosmer (M.I.T.) tells me that his students could readily pick up signals from a very small heliograph at about 20 miles—angle subtended a scant 0″.2.

Some experiments by Barnard[3] with a dark wire 0″.009 inch in diameter showed that it was visible when suspended against moderately bright sky up to 356 feet, angle subtended 0″.44. a figure down to something like 1/60 the diameter of the smallest spot ordinarily visible.

[1] Nagel, "Handbuch d. Physiologie d. Menschen," III., 340.

[2] *Berl. Klin. Woch.*, 1898, 20–22.

[3] *Pop. Ast.*, 1898, p. 1.

Later Lowell[4] tried out a similar experiment with the result of finding his wire visible easily at 0″.89, with some difficulty at 0″.83 and glimpsed down to 0″.69. Evidently his contrast conditions were less good than Barnard's. A further test by Slipher and Lampland[5] showed the wire disappearing from certain vision at 0″.86, while a dark blue line on a white disk held down to 0″.83. W. H. Pickering[6] experimenting with a dark human hair against open sky found it easily visible when subtending an angle of 1″.13, easily glimpsed at 0″.97, occasionally glimpsed at 0″.83, and quite invisible at 0″.72.

Taking up the converse case the writer first tried a German silver wire 0.01 inch diameter stretched zigzag in lengths of several feet over a dark plank bulkhead. The reflectivity of this varied from about 0.06 to 0.12, *i. e.*, a very dark gray. The test was in full sunshine and the observers, the place being the range of the Massachusetts Rifle Association, were a group of riflemen, keen of sight and experienced in close observation. The terrain was laid off in 50-foot spaces and the results were as follows: Wire vanished across lighter parts of background at 75 feet (2″.3) while across the darkest of that background the wire persisted up to 200–250 feet, beyond which it was invisible save for specular glints especially at twists. To summarize:

Angular Diameter	Appearance
1″.11	Parts against dark background were plain.
0″.86	Portions seem distinctly but not steadily.
0″.69	Visible at specular spots, difficultly glimpsed elsewhere.
0″.46	Visible by specular reflection only.

A second test with some of the same observers was made, using a background of black paper (coefficient .045), white thread 0.008 inch in diameter, and drawn tungsten wire 0.005 diameter. The paper was nailed to the former bulkhead and wire and thread stretched zigzag as before. Observed in bright skylight, also in moderately bright sunshine. The wire was visible with difficulty to one observer at 150 feet and beyond this disappeared utterly. To the others it could be fairly made out only at 100 feet. The thread, which was much brighter than the wire, began to be lost in parts at 200 feet, but in sunshine held rather indistinctly but unmistakably to 300 feet. When the sun went in the thread was lost at about 200 feet. To summarize again

	Angular Diameter	Appearance
Wire	0″.86	Limit for all but one observer.
	0″.57	Fairly seen by one observer.
Thread	0″.92	Network distinct all over.
	0″.69	Parts distinct in sunshine.
	0″.55	Parts evident in sunshine.
	0″.46	Near limit of visibility. Only small bits of network seen.

In the case of the thread the brightness contrast between thread and background was about 16:1. With brilliant sunshine and a background of even deader black there might have been a slight further gain, but we were evidently close to the limit. It is rather noteworthy that there should be so near an agreement throughout as between dark on bright and bright on dark, but barring specular direct reflection the brightness contrast which determines visibility is not widely different in the two cases, and the *minimum visibile* for a linear object with strongly contrasted background would appear to be about 0″.5 ±. It is certainly less than 1/50 the *minimum visibile* for a round spot giving similar contrast, a remarkable evidence of the efficient coordination of retinal impressions.

Boston Louis Bell

[4] *Bulletin Lowell Obs.*, No. 2.
[5] *Lowell Obs. Bull.* No. 10.
[6] *Pop. Ast.*, 23, 578.

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter